Remarks

1.1. In the official action of 12 June 2007, the Examiner has maintained his rejection of claims 1-4, 6-8, 10-20 (all current claims) relying on the Golem and Dufresne references previously cited and discussed.

1.2. The amendments to claims 1, 18 and 20 are by way of emphasis, that the regeneration which takes place in the claimed process is not carried out in a regenerator which is integrated with the reactor train. This the concept underlying the invention as originally disclosed, where the objective is to avoid or, at least, defer the cost of the moving bed regenerator.

1.3. Applicant adheres to the arguments previously presented in the response of 2 August 2006 and refers to that response for a complete statement and analysis of the present invention and its relationship to the prior art in general and to the cited references in particular[1]. In order for Applicants' arguments to be followed more easily, however, a summary of the invention and its relationship to the references is given below.

1.4. This present invention resides in a method or scheme for converting fixed bed catalytic reforming units to moving-bed reactor operation. The conversion, however, is not a full conversion in which, in the finished unit, the reforming catalyst moves continuously through the serial moving bed reactors and then to the continuous regenerator but rather, is a low-cost partial conversion in which the fixed bed reactors are removed and moving bed reactors installed but the conventional fully-integrated regenerator characteristic of a complete moving bed continuous regeneration unit is not used. Instead, continuous or intermittent catalyst feeding facilities are provided to allow continuous or intermittent addition of fresh or regenerated catalyst to the catalyst inlet of the moving-bed reactor and continuous or intermittent removal of spent catalyst from the catalyst outlet of the last moving-bed reactor in the train of reactors. The spent catalyst removed from the reactor is regenerated in a non-integrated regenerator which may be an offsite regenerator, a centrally located on-site regenerator which serves several

[1] There is an error in Section 2 of the response: in the next to last line of the section "lower" should read "higher".

reforming units or a regenerator shared with a second moving bed unit. The converted unit is operated at an effective reactor pressure to improve reformate quality and yield compared to the reformate product from the fixed-bed unit before the conversion. Typically, this reactor pressure will be lower than that of the fixed bed unit whose reactors have been replaced but higher than the pressure which would be used in a full conversion to a continuous catalytic regenerator reformer with its own dedicated reactor.

1.5. The Golem reference is a paper which describes the commercial success of the UOP CCR Platforming™ process and acknowledges that refining economics may not always favor complete unit conversions. Three options for obtaining some or all the benefits of CCR Platforming technology are proposed (page 6). These are:

Hybrid CCR Platforming process

Full CCR Platforming process

New, Second Generation CCR Platforming process

Of these options, two (the second and third) are the full conversions to CCR with moving bed reactors and fully-integrated moving bed regenerators. The only lower cost alternative to the complete CCR conversions is a conversion to the Hybrid CCR Platforming process which utilizes the existing fixed bed reactors and adds a final moving bed reactor with its own associated regenerator (Golem, page 6) although replacement of one of the original fixed-bed reactors by the moving bed reactor appears as an alternative (second paragraph, page 7). Thus, in the partial conversion described by Golem *fixed bed reactors are retained in the train.*

1.6. Dufresne discloses an offsite process (column 3, line 31; column 4, line 33) for the regeneration of a used hydrocarbon treatment catalyst. The spent catalyst which may be regenerated by this process may be "from a continuous and/or semi-regenerative type reforming process, i.e., a continuous type, semi-regenerative type or mixed type process." (column 4, lines 16-19) and in cases when the catalyst is from a continuous reforming process, the off-site regeneration is intended to deal with upset conditions (see column 2, lines 44-59) such as where there is an excess amount of coke deposited on the catalyst during the reforming reactions.

2.1 Applicants' submissions with respect to the patentability of the present claims will now be made, with reference where appropriate to the Examiner's remarks set out in the office action.

2.2.1. *The present claims are directed to a conversion method.*

The preambles to claims 1, 18 and 20, the only independent claims in the application are as follows:

1. A method for the conversion of a fixed-bed catalytic reformer unit to moving bed reactor operation without a dedicated continuous catalyst regenerator,....

18. A method for the conversion of a fixed-bed catalytic reformer unit to moving bed reactor operation without a dedicated continuous catalyst regenerator,...

20. A method for the conversion of a fixed-bed catalytic reformer unit to moving bed reactor operation,...

In each case, the method is defined by the acts which take place during the method as well as by reference to the manner of operation of the unit following the conversion. In the conversion itself, *each* fixed bed reforming reactor of the original fixed-bed unit is converted to a moving bed reactor (claims 1, 18, 20) also, catalyst feeding facilities are added at the catalyst inlet of the reactor train and spent catalyst recovery facilities at the end of the train (claims 1, 18, 20). No integrated regenerator is provided (claims 1, 18, 20) and regeneration is carried out in a separate regenerator which may be a shared regenerator in another unit (claim 20). The mode of unit operation after the conversion is defined as one in which the spent catalyst is transferred to a non-integrated regeneration facility (claims 1, 18, 20) while the unit is operated at a lower pressure than it was before the conversion, referring to the pressure of the fixed bed reactors (claims 1, 18, 20).

2.2.2. *The conversion method is not suggested by Golem and Dufresne*

The Examiner acknowledges that Golem does not disclose a non-integrated catalyst regeneration facility but takes the view that it would have been obvious to modify the

teachings of Golem by using an offsite regenerator as suggested by Dufresne on the basis that the use of an offsite regenerator as suggested by Dufresne would allow better control of the two principal regeneration steps (action, page 4).

It is not contested that Dufresne discloses offsite regeneration with its attendant advantages quite explicitly but even if, *ex hypothesi,* the Dufresne disclosure be read in the light of Golem to suggest the desirability of using offsite regeneration with a unit of the type described by Golem, there would still be no teaching of the presently claimed conversion method. Golem does not disclose or suggest the present conversion method in which *each* fixed bed reforming reactor of the original fixed-bed unit is converted to a moving bed reactor to form a unit with no integrated regenerator. In the Golem Hybrid conversion, the moving bed reactors are retained and so a key feature of the present claims, namely, that *each* fixed bed reactor is replaced by a moving bed reactor is not met. In addition, a regenerator for the moving bed reactor is installed (Golem, page 7). In the full CCR Platforming conventions (second and third Golem options), all the former fixed bed reactors are replaced, admittedly, but in these cases, a fully integrated, dedicated regenerator is installed. Claims 1, 18 and 20 preclude the presence of the dedicated regenerator which is part of each of the two full conversion schemes described by Golem. Claim 20 requires the use of a shared regenerator which is integrated with another reactor train (as described, for example, in Section 0012) and Golem does not suggest such a manner of operation at all. Thus, the revamps described by Golem are different to the presently claimed scheme and even if Dufresne be read in the light of Golem to suggest the desirability of off-site regeneration after one of Golem's conversions, the claimed overall conversion and operational scheme is not rendered obvious.

The Examiner has asserted that "The revamp in the manner disclosed by Golem is believed to result in a unit that is operated as claimed" (office action, page 4, top). For purposes of analysis, it might have assisted consideration if the Examiner had made clear which of the Golem revamp options was in mind here since, as pointed out above, there are three revamp options described. In any event, however, none of the Golem options makes the same conversion steps "to result in a unit that is operated as claimed". The Golem Hybrid option retains fixed bed reactors rather than converting each of them and the full conversion options offered by Golem – which the present

invention is directed to avoiding – utilize a dedicated, integrated regenerator which is not in accordance with the claimed conversion scheme.

As far as the Examiner's point about the pressure of the operation is concerned (office action, page 4), Golem concededly contemplates operation of the retained moving bed reactors with a "moderate pressure reduction" (page 6, bottom) in the Hybrid case and in the full conversions, a significant pressure reduction will also occur. The Hybrid case, however, is not the same conversion scheme now claimed. As pointed out above, the present invention provides a *different* scheme which is, in fact, intended to achieve most of the advantages of moving bed operation at lower cost and it does this by going to an operation which is entirely based on moving bed reactors, unlike Golem's Hybrid scheme which still retains fixed bed reactors rather than eliminating them. Golem's full conversions are also different in that a dedicated, integrated regenerator is installed, contrary to the concept underlying the present invention which is to avoid the high cost of the regenerator. Again, Golem's disclosure does not support the rejection as made.

The Examiner's supposed counter (office action, page 8) that because Golem discloses "[R]eplacement of the existing side-by-side reactor train with a modern, moving bed stacked reactor system" (citing Golem page 13, paragraph 1), Applicants' position set out above is incorrect, is a canard. The replacement referred to here by Golem is the *full* conversion in which all fixed bed reactors are replaced by moving bed reactors (as in the present invention) but Golem goes on also to install an integrated regenerator with its incident high cost as recognized by Golem: "*The cost of a larger regenerator is significant* and the project cost approaches that of a full CCR Platforming conversion." (Golem, page 7, foot). The fact is Golem does not disclose or suggest replacement of a complete fixed bed reactor train by a moving bed reactor train without its associate integrated regenerator.

Incidentally, the Examiner's suggestion that "The actual pressures used would be based on the desired composition of the product and one having ordinary skill in the art would adjust such pressures accordingly" (action, page 4) is a rather too simple description of the manner in which the operating pressure for a reformer is set. The composition of the product is certainly one of the factors in the selection of appropriate operating conditions since low hydrogen partial pressure will favor the desired production of aromatics but, at

the same time, low hydrogen pressure will increase coke production and so, reaction conditions including pressure must be a compromise between high conversion to aromatics coupled with an acceptable rate of catalyst deactivation. See, for example, *Modern Petroleum Technology*, 4th Edition, Hobson et al (ed.), Applied Science Publishers Ltd., 1973, ISBN 085334 487 6, pp. 330, 337, attached. So, the skilled person would select the pressure to be used in the process in accordance with established principles in which the composition of the product would be but one factor.

2.3.2. *Golem's "phased approach" is not a disclosure of non-integrated regeneration*

On pages 5-6 of the action, the Examiner has argued that Applicants' position that Golem's three conversion options do not result in a scheme of the type claimed is "not persuasive". In support of his position, the Examiner states that Golem discloses the following:

> "If the revamp is the first step in a phased approach toward full CCR (continuous catalyst regeneration) platforming operations, the CCR regenerator is sized for use with the last moving bed reactor and a future reactor stack, which replaces the side-by-side reactors, or with a future reactor stack that replaces the entire reactor train".

From this, the Examiner continues by pointing out that Figures 9-11 of Golem "clearly show regenerator units separate from the reactor train" and from this concludes that "[T]his regenerator can be operated as a non-integrated regeneration facility or as a shared regenerator".

With respect, neither the quotation nor the Figures, nor the reasoning based on them, support a conclusion of obviousness. First, when a phased approach revamp is carried out, according to Golem, an oversized CCR regenerator is installed, to be big enough for the last moving bed reactor and a future moving bed reactor stack. The Examiner is correct in stating that such a regenerator "can" (*sic*) be operated as a non-integrated regeneration facility or as a shared regenerator. But mere capability is not the test of obviousness under 35 USC 103. For the claimed invention to be obvious within the purview of 35 USC 103, the prior art in and of itself must speak to the desirability of the claimed elements. *In re Gordon* 221 USPQ 1125, 1127 (Fed. Cir. 1984). So, the fact that the oversized regenerator of Golem's "phased approach" unit "can" be operated as

a non-integrated facility or as a shared regenerator does not posit a proper test of obviousness.

That Figures 9-11 of Golem show regenerators "separate from the reactor train" is hardly surprising. The regenerator is always constructed with some separation from the reactors both for reasons of design convenience and also for safety: the regenerator has its own requirements in terms of feeds and utilities (air, power) and it is obviously easier to design the regenerator around these factors, especially in the case of the "phased approach" when the regenerator is to have design criteria not fixed by the initial state of the reactors. Second, safety plays a significant part in the design considerations: the reactors work in a high temperature, hydrogen-rich atmosphere where as the regenerator operates in a high temperature, oxygenated atmosphere, a sure formula for disaster if the two atmospheres should become mixed. Thorough purging of the spent catalyst is required before it can enter the regenerator both to remove occluded hydrogen as well as hydrocarbons. The depiction of the regenerator as a separate component or sub-unit in Figures 9-11 of the Golem reference therefore provides no indication that the skilled person would interpret that disclosure as pointing towards the use of a moving bed reactor train without an integrated regenerator (claims 1, 18) or of a shared regenerator (claim 20).

2.3.3. *The disclosed advantages of Dufresne's off-site regeneration do not motivate the use of non-integrated regenerators for use with units having no integrated regenerator.*

Dufresne discloses the advantages of his off-site regeneration process with its two characteristic steps of oxidative coke removal followed by oxyhalogenation, each carried out under carefully controlled conditions. The process is described as one which is capable of delivering a regenerated catalyst of improved characteristics (noble metal dispersion, surface area). These advantages concededly provide an incentive to use the Dufresne process in its intended manner which, as previously pointed out is as an adjunct to the normal CCR continuous regeneration in units with a train of moving bed reactors. Dufresne's process enables the refiner to avoid costly low-capacity operation or a costly catalyst changeout with a CCR unit (col. 2, ll. 44-59). In the case of a semi-regenerative unit (col. 2, ll 60-65), the down time following an upset may be even longer.

The context in which the Dufresne regeneration conceptually would take place following a unit conversion as taught by Golem, therefore, is as follows:

Golem Hybrid Conversion: Not all fixed bed reactors replaced. Dufresne process used for fixed bed catalyst at normal regeneration intervals and for moving bed catalyst after upsets. No suggestion that the hybrid converted unit should be built without integrated regenerator for the moving bed reactor(s) – in fact, Golem is to the contrary in stating that "CCR technology *requires* a moving bed reactor and a new regenerator" (Golem, page 7, fourth paragraph, emphasis added).

Golem Full CCR Conversion: All fixed bed reactors are replaced. Dufresne process used for catalyst after upsets. No suggestion that the converted unit should be built without integrated regenerator – in fact, Golem is to the contrary in stating that "Conversion to the full CCR technology requires replacement of the existing rector train with a modern moving bed reactor system. A new CCR regenerator is added....." (Golem, page 8, third paragraph).

In either case, the fact that Golem does not suggest a unit conversion of all the original fixed bed reactors with moving bed reactors but no integrated regenerator makes the assertion of obviousness untenable, what motivation Dufresne's advantages might be.

The Examiner's argument (office action, page 9, foot) that the Dufresne invention applies not only to occasional departures from conventional integrated regeneration in the event of a unit upset but also to normal operation is correct for semi-regenerative operation but since Golem does not suggest unit conversion without an integrated regenerator, the point is not relevant since no hypothetical combination of Golem and Dufresne can arrive at the presently claimed invention. Dufresne spoke only to regeneration with the types of unit that were known, that is, to semi-regenerative units (fixed bed) and to CCR units and to units of the hybrid type with both fixed and moving bed reactors in which each type of reactor had its own catalyst and associated regeneration requirements. Dufresne did not speak to use with units of unknown type such as those now claimed and which are not taught by Golem, namely, units with only moving bed reactors but no integrated regenerator.

2.3.4. *Golem and Dufresne do not disclose or suggest the use of a shared regenerator*

Claim 20 is directed to the shared regenerator option under the present invention. The Examiner takes the view (office action, page 10, foot) that Golem shows an arrangement in Figures 10 and 11 where the regenerator is supplying the catalyst to the reforming unit. This, of course, is the normal manner of operation for a CCR regenerator. Dufresne, in its teaching of offsite regeneration of catalyst from a CCR unit requires that the catalyst be taken from the last reactor and then to the offsite regenerator. The offsite regeneration facility disclosed by Dufresne, however, is one which includes a moving bed furnace, a rotolouvre furnace or a belt furnace (column 4, ll. 4-9). None of these types is a shared regenerator and there is no suggestion that a regenerator from another CCR type unit might be used and so, the Examiner's positon is not factually supported by the reference disclosure.

In view of the amendment and remarks set out above, reconsideration and withdrawal of the rejection are requested.

For the Applicants,

Attorney for Applicant(s)
Registration No. 27,728
Telephone Number: (703) 846-7795
Facsimile Number: (703) 846-7799

☐ Pursuant to 37 CFR 1.34(a)

ExxonMobil Research and Engineering Company
P. O. Box 900
Annandale, NJ 08801-0900